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The scolopendromorph centipedes (Chilopoda) of Taiwan

by

Jui-Lung Chao and **Hsueh-Wen Chang***

(Department of Biological Sciences, National Sun Yat-Sen University, Kaohsiung, Taiwan, 804, R. O. C.; hwchang@mail.nsysu.edu.tw; * correspondence to be addressed)

ABSTRACT

Between 1991 and 2002 more than 300 specimens of scolopendromorphs were collected from 100 sites in Taiwan. In total, 16 species and subspecies in the genera, *Cryptops, Otostigmus, Rhysida, Scolopendra,* and *Scolopocryptops* were identified. A key to the scolopendromorph genera and species of Taiwan is presented. Three species not previously recorded from Taiwan, nor present amongst the specimens examined from several museums, namely *Cryptops japonicus* Takakuwa, 1934, *Scolopocryptops capillipedatus* (Takakuwa, 1938), and *Scolopocryptops melanostomus melanostomus* (Newport, 1845), were collected in this study. *Scolopendra multidens* Newport, 1844, formerly regarded as a subspecies of *Scolopendra subspinipes* Leach, 1815, is considered a valid species. *Scolopendra subspinipes mutilans* L. Koch, 1878 may be a young *S. subspinipes subspinipes*. *Scolopendra subspinipes japonica* may be a subspecies or a geographic variation of *S. multidens*, but this requires further investigation. Five previously recorded species and two subspecies have not been found on the island in this study. It is proposed that *Rhysida longipes brevicornis* Takakuwa, 1934 = *Rhysida longipes longipes* (Newport, 1845), *Rhysida nuda brevicornis* Wang, 1951 = *Rhysida immarginata immarginata* (Porat, 1876), and *Otostigmus insularis* Hasse, 1887 = *Otostigmus scaber* Porat, 1876. *Otostigmus striatus* Takakuwa, 1940 may be a synonym of *O. scaber*. *Otostigmus multispinosus* Takakuwa, 1937 may be an inaccurately described *O. aculeatus* Haase, 1887.

INTRODUCTION

The scolopendromorphs of Taiwan were studied by Takakuwa (1940*a,b*) and Wang (1955*a,b* 1956 1957 1958 1959 1962 1963). Together they listed 24 species or subspecies from five genera: *Cryptops*, *Otocryptops (*now *Scolopocryptops* (Crabill 1953)), *Otostigmus*, *Rhysida*, and *Scolopendra*. However, the specimens of Takakuwa's publication were destroyed during World War II, and Wang's specimens have been lost.

Over the past forty years, the economics and environment of Taiwan have changed rapidly. Human activity has decreased Taiwan's biodiversity. Pesticides have been used extensively, and as scolopendromorphs inhabit soil, the diversity and distribution of Taiwanese Scolopendromorpha may have changed a great deal. Therefore, it was necessary to recollect Taiwanese scolopendromorphs and revise the faunistic list. In order to facilitate future studies of the fauna, a key to the five genera and all species was developed. We examined more than 300 specimens collected from 100 sites from Taiwan and adjacent islands (Fig. 21). Sixteen species or subspecies from five genera were identified (Table 1).

KEY TO TAIWANESE GENERA AND SPECIES OF SCOLOPENDROMORPHA

1 Eyes present; tarsi of legs with 2 segments; sternites usually with 2 paramedian longitudinal sutures; forcipular coxosternite with toothplate and teeth .... **Family Scolopendridae** (2)

– Eyes absent; tarsi of legs with 1 segment; sternites usually with a single median suture, often with a transverse suture; forcipular coxosternal toothplate reduced or absent .... **Family Cryptopidae** (9)

TABLE 1.

Faunistic list of scolopendromorphs of Taiwan by Takakuwa (1940*a*,*b*), Wang (1955*a*,*b* 1956 1957 1958 1959 1962 1963) and this study. + = present.

Taxa	Takakuwa	Wang	This study
Family Scolopendridae			
Subfamily Scolopendrinae			
Scolopendra morsitans Linnaeus, 1758	+	+	+
Scolopendra multidens Newport, 1844	+	+	+
Scolopendra subspinipes dehaani Brandt, 1840	–	+	–
Scolopendra s. japonica L. Koch, 1878	–	+	–
Scolopendra s. mutilans L. Koch, 1878	+	+	+
Scolopendra s. subspinipes Leach, 1815	+	+	+
Subfamily Otostigminae			
Otostigmus aculeatus Haase, 1887	–	+	+
= *Otostigmus multispinosus* Takakuwa, 1937	+	–	
Otostigmus astenus (Kohlrausch, 1881)	–	+	+
Otostigmus scaber Porat, 1876	+	+	+
= *Otostigmus insularis* Hasse, 1887	–	+	
= *Otostigmus malayanus* Chamberlin, 1914	–	+	
= *Otostigmus striatus* Takakuwa, 1940	+	+	
Otostigmus politus pigmentatus Attems, 1930	–	+	–
Rhysida immarginata (Porat, 1876)			+
= *Rhysida nuda immarginata* (Porat, 1876)	+	+	
= *Rhysida n. brevicornuta* Wang, 1951		+	
Rhysida longipes longipes (Newport, 1845)	–	+	+
= *Rhysida l. brevicornis* Takakuwa, 1934	+	+	
Rhysida yanagiharai Takakuwa, 1935	+	–	–
Family Cryptopidae			
Subfamily Cryptopinae			
Cryptops japonicus Takakuwa, 1934	–	–	+
Cryptops nigropictus Takakuwa, 1936	+	+	+
Subfamily Scolopocryptopinae			
Scolopocryptops capillipedatus (Takakuwa, 1938)	–	–	+
Scolopocryptops curtus (Takakuwa, 1939)	+	–	+
Scolopocryptops melanostomus melanostomus (Newport, 1845)	–	–	+
Scolopocryptops rubiginosus (L. Koch, 1878)	+	+	+
Scolopocryptops sexspinosus (Say, 1821)	+	+	+

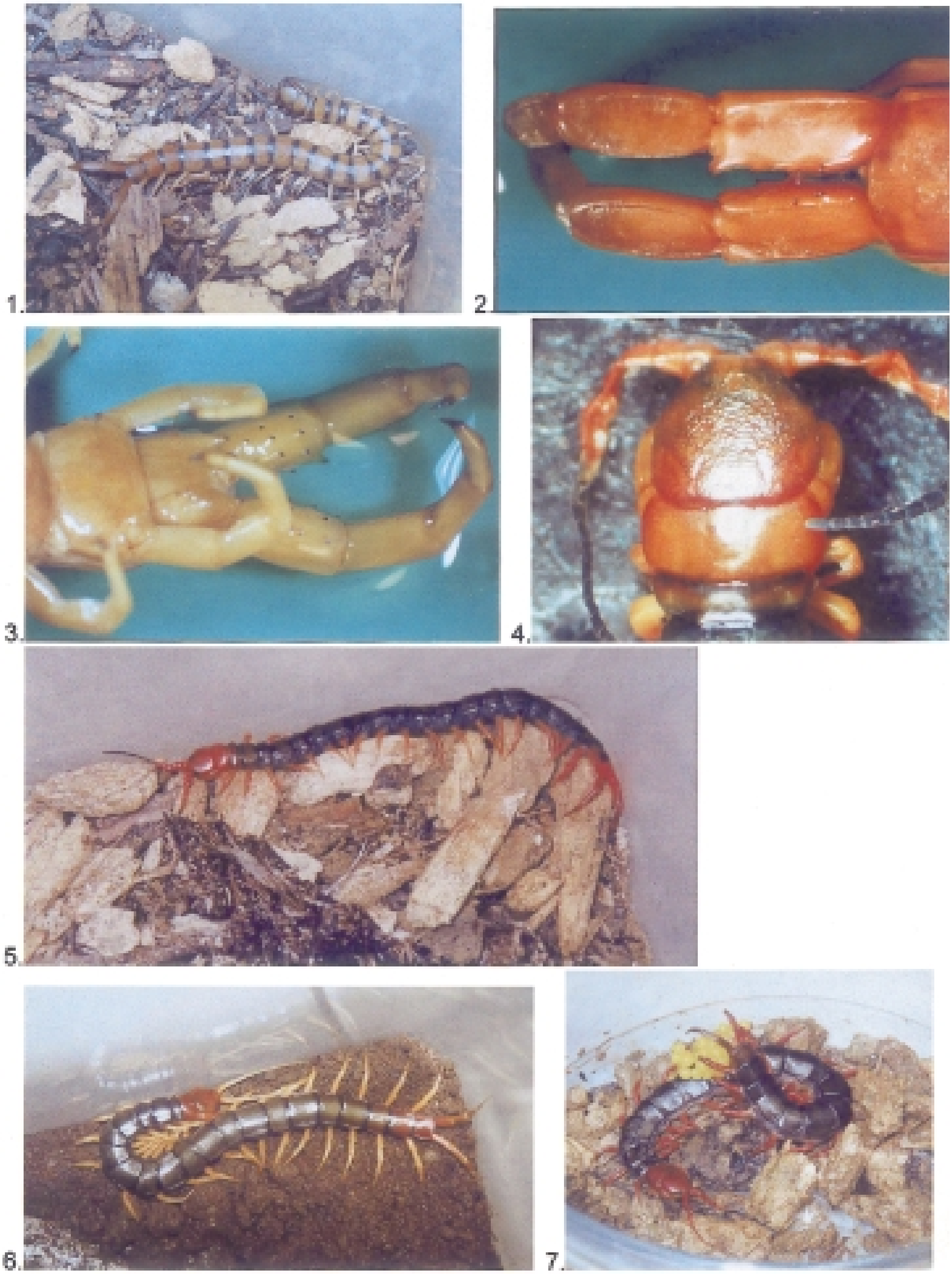
2 Spiracle triangular, divided horizontally by 3 flaps; legs with one tarsal spine or absent, with 2 claw spines and 1st tarsus longer than 2nd, rarely equal in length; tergite one covered by head plate .... **Scolopendra** Linnaeus, 1758 (3)

– Spiracle oval or circular, without flaps; anterior legs with 2 tarsal spines, posterior legs with one tarsal spine or absent; head plate covered by tergite one 5

3 Prefemur of end legs with 9 ventral spines in 3 rows (Fig. 3); prefemur and femur of end legs of males dorsally ellipsoid flattened, and with swollen margins (Fig. 2) .... **S. morsitans** Linnaeus, 1758

Prefemur of end legs with 2–3 (rarely 4) ventrolateral spines.............................. 4

4 Leg 20 without tarsal spines; head plate with large punctures; coxopleural process with 3 terminal spines; first genital sternite without a pair of small genital appendages in males .... **S. multidens** Newport, 1844



Figs 1–7. Characteristics of *Scolopendra* species. 1–3. *S. morsitans* Linnaeus, 1758. 1. General body form and coloration. 2. End legs dorsally flattened and with swollen margins. 3. Prefemur of end legs with three rows of nine ventral spines. 4–5. *S. multidens* Newport, 1844. 4. Head region, showing large punctures. 6–7. *S. subspinipes mutilans* L. Koch, 1878. 6. Yellow-leg form. 7. Red-leg form.

– Leg 20 with a tarsal spine; head plate with small punctures; coxopleural process mostly with 2 terminal spines, with a pair of small genital appendages in males (Fig. 8) .... **S. subspinipes** Leach, 1815

5 7th body segment with a pair of spiracles; spiracles cribriform, floor of atrium with raised humps (Fig. 10) .... **Rhysida** H. C. Wood, 1862 (6)

– 7th body segment without spiracles; spiracle simple, without humps .... **Otostigmus** Porat, 1876 (7)

6 Only tergite 21 laterally marginate; end leg prefemur with 2 ventrolateral, 1 ventromedial and 1 dorsomedial spine (Fig. 12), without a corner spine.............. **R. immarginata immarginata** (Porat, 1876)

– Posterior tergites (not only 21) laterally marginate (Fig. 11); end leg prefemur with a row of 3 ventrolateral, a row of 3 ventromedial and a row of 2–3 dorsomedial spines .... **R. longipes longipes** (Newport, 1845)

7 Posterior tergites with 7–9 longitudinal keels and numerous small spines (Fig. 14) .... **O. scaber** Porat, 1876

– Tergites smooth, without spines and keels.. 8

8 Basal 2 and part of antennomere 3 glabrous; last sternite square (Fig. 15); end leg prefemur with 4 rows of spines .... **O. astenus** Kohlrausch, 1881

– Basal 3 antennomeres glabrous; last sternite with sides convergent and hind border concave; end leg prefemur with 5 rows of 5–9 small spines (Fig. 13) .... **O. aculeatus** Haase, 1887

9 With 23 pairs of legs; 10 pairs of spiracles, 7th body segment without spiracles; toothplate reduced and replaced with dental margin; prefemur of end legs with a large ventral and a small lateral spine........ **Scolopocryptops** Newport, 1844 (10)

– With 21 pairs of trunk legs; 9 pairs of spiracles, 7th body segment without spiracles; toothplate absent, without dental margin; forcipular prefemural process absent; coxopleural process absent; end leg prefemur without large separate spines, its tibia and 1st tarsus with a ventral longitudinal row of curved teeth .... **Cryptops** Leach, 1815 (14)

10 Femur, tibia and tarsus of end legs with numerous long hairs (Fig. 17) 11

– Femur, tibia and tarsus of end legs hairless 12

11 Tergites with 2 paramedian sutures; basal 4 antennomeres glabrous .... **S. melanostoma melanostoma** (Newport, 1845)

– Tergites without paramedian sutures; basal 2 antennomeres glabrous .... **S. capillipedatus** (Takakuwa, 1938)

12 Tergites with 2 paramedian sutures 13

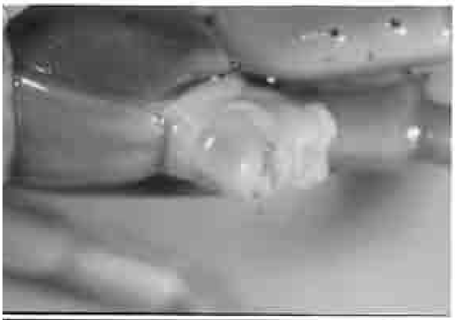
– Tergites without paramedian sutures .... **S. sexspinosus** (Say, 1821)

13 Coxopleural process with a median spine (Fig. 19); headplate laterally marginated .... **S. rubiginosus** (L. Koch, 1878)

– Coxopleural process with a very short spine (Fig. 20); head plate without margin .... **S. curtus** (Takakuwa, 1939)

14 Femur of end legs with a ventral curved tooth (Fig. 16) .... **C. japonicus** Takakuwa, 1934

– Femur of end legs without a ventral curved tooth .... **C. nigropictus** Takakuwa, 1936



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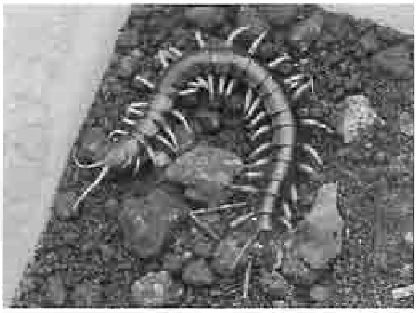

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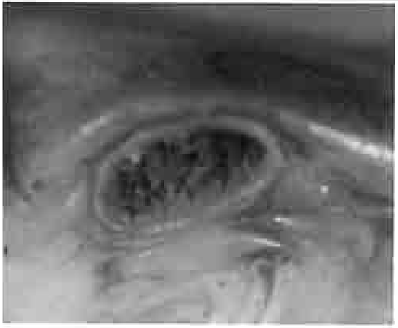

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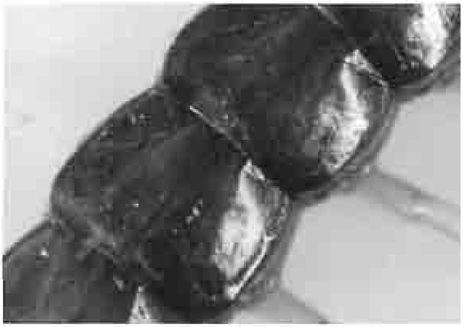

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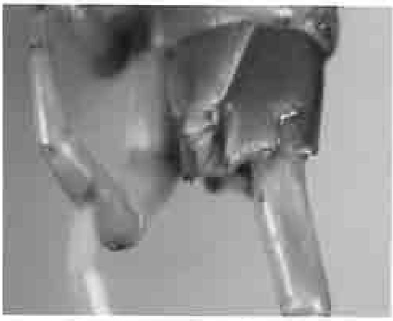

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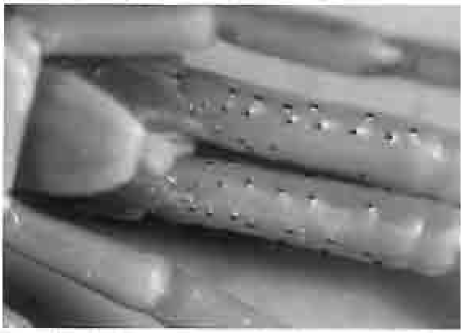

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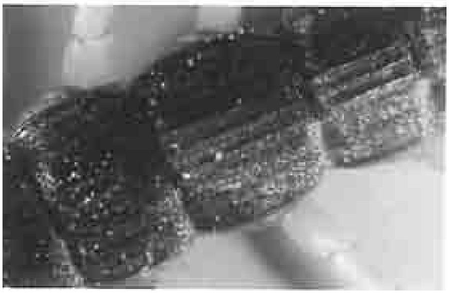

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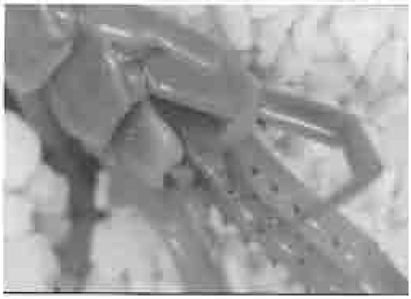

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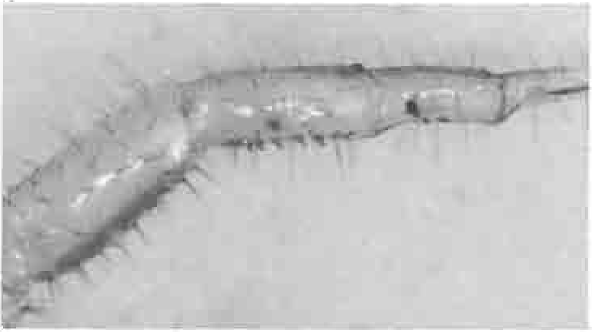
Figs 8–15. Characteristics of *Scolopendra*, *Rhysida* and *Otostigmus* species: 8. *S. subspinipes mutilans* L. Koch, 1878: pair of small genital appendages. 9. *S. subspinipes subspinipes* Leach, 1815: general body coloration and form. 10–11. *R. longipes longipes* (Newport, 1845). 10. Spiracle with raised bumps. 11. Tergites 7–8 (marginate laterally). 12. *R. nuda immarginata* (Porat, 1876): coxalpleural process and end legs. 13. *O. aculeatus* Haase, 1887: end legs. 14. *O. scaber* Porat, 1876: tergites 17–19. 15. *O. astenus* (Kohlrausch, 1881): last sternite and end legs.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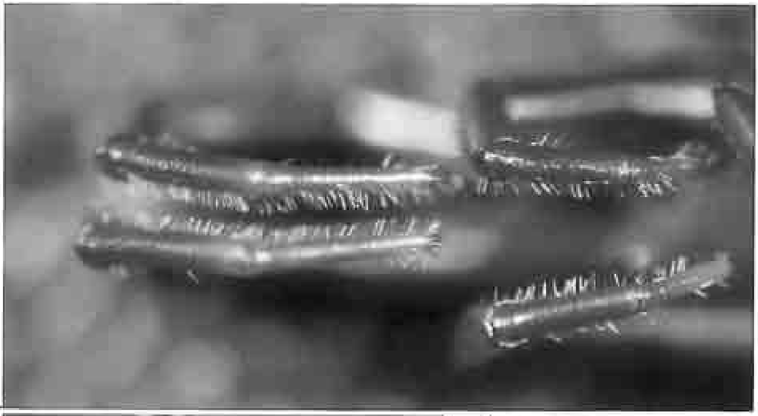
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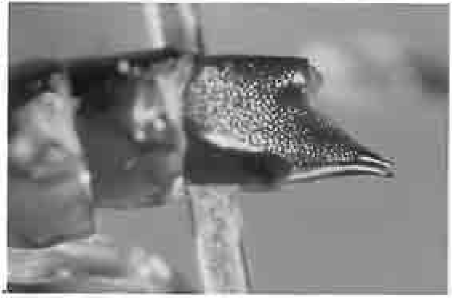
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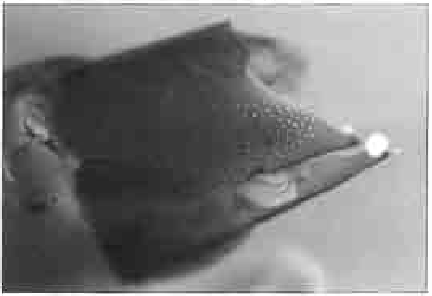
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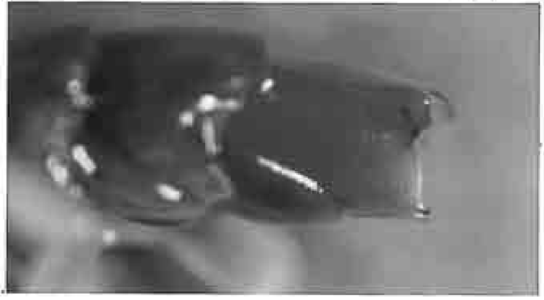
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Figs 16–20. Characters of *Cryptops* and *Scolopocryptops* species. 16. *C. japonicus* Takakuwa, 1934: end leg. 17. *S. capillipedatus* (Takakuwa, 1938): end legs. 18. *S. melanostomus melanostomus* Newport, 1845: coxopleural process. 19. *S. rubiginosus* (L. Koch, 1878): coxopleural process. 20. *S. curtus* (Takakuwa, 1939): coxopleural process.

RESULTS AND DISCUSSION

Wang (1955*a* 1956) recorded two species of *Scolopendra* from Taiwan (*S. morsitans* and *S. subspinipes*), the latter represented by five subspecies (*S. subspinipes subspinipes* Leach, 1815, *S. s. mutilans* L. Koch, 1878, *S. s. multidens* Newport, 1844, *S. s. dehaani* Brandt, 1840 and *S. s. japonica* L. Koch, 1878). During the present investigation, no examples of the subspecies *S. s. dehaani* and *S. s. japonica* were found. The survey showed that *S. s. mutilans* was widespread in Taiwan and Pescadore Islets, while *S.* s. *multidens* was found only in the north, *S. s. subspinipes* in the south, and *S. morsitans* on Lanyu islet, Pescadore Islets, and in the north.

Scolopendra multidens is actually a valid species distinguished by the absence of genital appendages in males, which are present in *S. subspinipes*, *S. s. mutilans*, and

TABLE 2.

Taxonomic characters of *Scolopendra multidens, S. subspinipes japonica*, *S. subspinipes mutilans* and *S. subspinipes subspinipes* in specimens from Institute of Zoology, China Academia Science; National Museum of Natural Science, Taiwan; and the Natural History Museum, London.

Characters	***S. multidens***	***S. s. japonica***	***S. s. mutilans***	***S. s. subspinipes***
Shape Maximum length and width (mm)	Wide: 170 long 13.8 breadth	Slender; 75 long 6.2 breadth	Wide; 14 long 12.5 breadth	Wide; 153 long 13 breadth
Colour	Dichromatic: Head, tergite 1 red, other terites dark green, antenna basally orange, but distally dark green, legs reddish orange	Monochromatic: Head, tergite 1 dark reddish green, other tergites dark green, legs dark yellow	Dichromatic: Head, tergite 1 red or reddish brown other tergites dark green, antenna red, dark green or yellow, legs red or yellow	Monochromatic: Head, tergite 1 dark brown, other tergites dark brown. antenna yellow, legs yellow
Genital appendages male)	Absent	Present	Present	Present
Punctures on headplate	Large	Small	Small	Small
Tarsal spine of leg 20	Absent	Absent	Present	Present
Position of first paramedian sutures (tergite number)	2–4 (2 in Attems 1930)	6 (3 in Attems 1930)	4–6 (4–9 in Attems 1930, 5–6 in Miyoshi 1982)	4 (2–6 in Zhang 1987, 3 in Attems 1930)
Position of first tergite margine (tergite number)	10–16 (10–14 in Zhang 1987)	1	5–9	4–6
Terminal spines of coxopleural process	3	3	2 or 3	2 (rarely 1 or 3)
Distribution of specimens examined	Northern Taiwan	Japan	Widespread over Taiwan Island and Pescadore Islets	Southern Taiwan

S. s. japonica (Table 2). In addition, *S. multidens* has a lot of large punctures on the headplate (Fig. 4), compared with small punctures in *S. subspinipes*, *S. s. mutilans*, and *S. s. japonica*.

It is difficult to separate the subspecies of *S. subspinipes* using Attems' (1930) key. Takakuwa (1940*b*) suggested that it was easy to separate the subspecies by body colour, and two groups could be distinguished. One group was characterised by monochromatic head and body, brown in *S. s. subspinipes* (Fig. 9) and green in *S. s. japonica*. The other group was dichromatic in head and body, *S. s. mutilans* with reddish brown head and *S. multidens* with red head. There are two types of body colour in *S. s. mutilans* (Figs 6, 7): one is with reddish brown head and yellow legs (yellow-leg type), which is present on Taiwan island; the other with red head and red legs (red-leg type), which is present only in the Pescadore Islets. The morphological characters of the red-leg type are the same as the yellow-leg type. We found that the external form of the red-leg type of *S. s. mutilans* is very similar to *S. multidens*, which has a red head and legs (Figs 5, 7), but they have different morphological characters (Table 2). It is questionable whether body colour as a character should be used to separate *S. s. mutilans* from *S. multidens*.

Takakuwa (1934) described the new subspecies *Rhysida longipes brevicornis* based on specimens collected from Tainan, Taiwan, and stated that the main differences between the two subspecies of *R. longipes*, namely *R. l. brevicornis* Takakuwa, 1934 and *R. l. longipes* (Newport, 1845) are the length of antennae (shorter in *R. l. brevicornis*, not reaching beyond tergite 4; reaching beyond tergite 6 in *R. l. longipes*) and the angle of the basal sulci of the toothplate (obtuse angle in *R. l. brevicornis*; right angle in *R. l. longipes*). We measured the angle of the basal sulci of the toothplate of 34 Taiwanese specimens of *R. longipes*, including five specimens from Tainan, and the mean is 120° (range 108–138°). In addition, the antennae of these specimens mostly reached between tergite 4 and 6 (rarely beyond tergite 6). It seems that the diagnostic characters Takakuwa proposed to differentiate the two subspecies are not valid. We conclude that *R. l. brevicornis* is a junior synonym of *R. l. longipes*.

Wang (1951) described the new subspecies *R. nuda brevicornis*, characterised by short antennae, which he later (Wang 1953) referred to as *R. n. brevicornuta*. This is a junior synonym of *R. immarginata immarginata* (Porat, 1876) (Lewis 2001).

Lewis (2002) suggested that *Otostigmus malayanus* Chamberlin, 1914 is a junior synonym of *O. insularis* and that *O. insularis* and *O. scaber* are probably conspecific, namely *O. scaber*. We examined some Taiwanese specimens of *O. scaber* and favour this opinion. Also, we did not find any specimens of *O. striatus* Takakuwa, 1940 at the site where Takakuwa (1940a) reported it. Only *O. insularis* was found. As both have the same spination of the coxopleural process (three terminal spines, two lateral spines and one dorsal spine), the same sternites, and similar tergites (with nine rows longitudinal keels; with numerous small spinous streaks between keels), we suggest that *O. striatus* and *O. scaber* may be the same species.

Takakuwa (1937) described the new species *O. multispinosus* Takakuwa, 1937 on specimens collected from Tainan, Taiwan. The species is similar to *O. aculeatus* Haase, 1887, and only differs in spinations of the prefemur of end legs (four rows

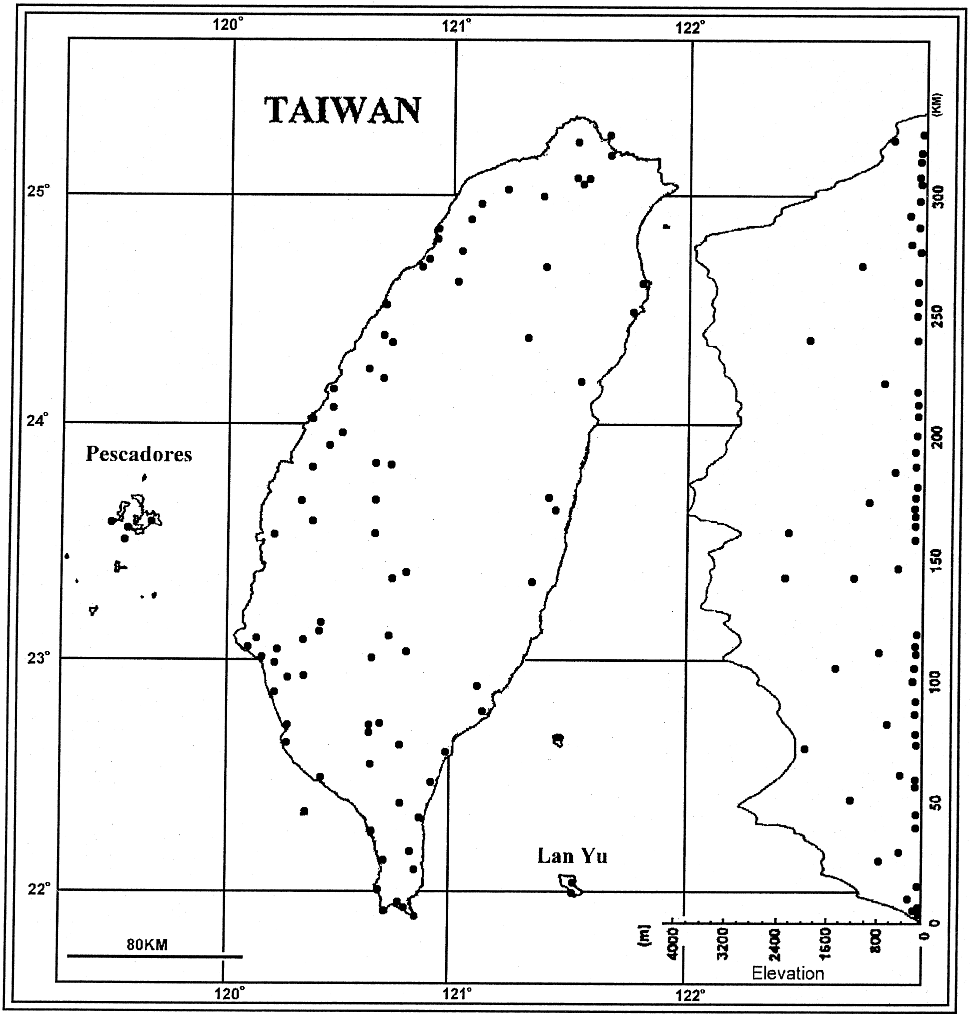

Fig. 21. Map of Taiwan and associated islands showing collecting localities, 1991–2001.

of spines in *O. multispinosus*; five rows of spines in *O. aculeatus*, Table 3). In this study, we did not find any specimens resembling the description of *O. multispinosus*, and material collected from Tainan matches the description of *O. aculeatus*, which is widely distributed in Taiwan. *Otostigmus multispinosus* could have been misidentified by Takakuwa.

Three species not recorded for the Taiwanese fauna by Takakuwa (1940*a,b*) and Wang (1955–1963), nor present amongst the specimens examined from several museums, namely *Cryptops japonicus* Takakuwa, 1934, *Scolopocryptops capillipedatus* (Takakuwa, 1938), and *Scolopocryptops melanostomus melanostomus* (Newport, 1845), are new records for Taiwan. *Scolopocryptops m. melanostomus* is distributed in East Asia, Middle America and South America (Takakuwa 1939; Wang 1962). We collected two specimens of *S. m. melanostomus* from a broad-leaved forest at Lanyu Islet.

TABLE 3.

Comparison of end legs as previously described for *O. multispinosus* and *O. aculeatus*, with Taiwanese specimens examined in the current study.

	O. multispinosus	*O. aculeatus*	Taiwanese specimens
Spines of prefemur	4 rows (1 ventromedian, 2 ventrolateral, 1 median, none dorsal)	5 rows 2 ventromedian, 2 ventrolateral, 1 dorsomedian)	5 rows (2 ventromedian, 2 ventrolateral, 1 dorsomedian)
Corn spine	Absent	Present	Present or absent

Takakuwa (1938) described *S. capillipedatus* from specimens collected from Korea, and this species was also recorded from Japan (Miyoshi 1982). We found it in the conifer forests of the mountains of Taiwan. *Cryptops japonicus* was previously known from Japan, Korea, and Manchuria (Takakuwa 1936), and we collected this species widely in Taiwan in humus and under fallen leaves.

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